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भारतीय मानक

टंड तुला — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

BEAM SCALES — SPECIFICATION

(Second Revision)

UDC 681·261

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 1990

Price Group 4

Commercial Weights and Measures Sectional Committee, LMD 06

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards on 12 February 1990, after the draft finalized by the Commercial Weights and Measures Sectional Committee had been approved by the Light Mechanical Engineering Division Council.

This standard was originally published in 1960 and subsequently revised in 1965. This revision is based on further experience gained in manufacture of commercial weighing instruments and other developments in this field.

In determining the limits for sensitiveness and greatest error for the different classes of beam scales, due weightage was given to the views of testing authorities and manufacturers and also to the practice prevailing on the continent and in U.K. The permissible limits given in Tables 1 to 4 are for new instruments only.

In formulation of this standard assistance have been derived from the rules of Weights and Measures prevailing in the country and technical help from the National Physical Laboratory, New Delhi.

Indian Standard
BEAM SCALES — SPECIFICATION
(Second Revision)

1 SCOPE

1.1 This standard covers the requirements for beam scales of four classes meant for commercial purposes (*see* 3.3).

2 REFERENCES

2.1 The following Indian standards are necessary adjuncts to this standard.

IS No.	*Title*
306 : 1983	Tin bronze ingots and castings (*third revision*)
737 : 1986	Wrought aluminium and aluminium alloys sheet and strip for general engineering purposes (*third revision*)
1432 : 1959	General requirements for weighing instruments
2062 : 1984	Weldable structural steel (*third revision*)

3 DEFINITIONS

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Beam Scale

A weighing instrument with equal arms, having three knife-edges, three bearings, an indicator (pointer) in the centre, and pans suspended from the end knife-edges (*see* Fig. 1).

3.2 Sensitiveness of a Beam Scale

A measure of its responsiveness to a small change in load in one of the pans, under specified conditions of loading; this can be expressed as the ratio between the change in mass in one of the pans and the corresponding deflection of the beam (or of the attached pointer) caused by the change.

3.2.1 In the case of the beam scale fitted with a pointer and an indicating scale, it is expressed in terms of milligrams per division.

3.2.2 In the case of a beam scale having no indicating scale, it is expressed as the least weight, required to be added to or removed from one of the pans, which causes an appreciable movement of the pointer from its position of equilibrium under a specified condition of loading.

NOTES

1 Sensitivity figures shall be determined only for those beam scales which have the pointer with the sector plate or the scale. For other beam scales the sensitiveness test shall apply.

2 All class 'A' beam scales shall be provided with a pointer with sector plate or the scale.

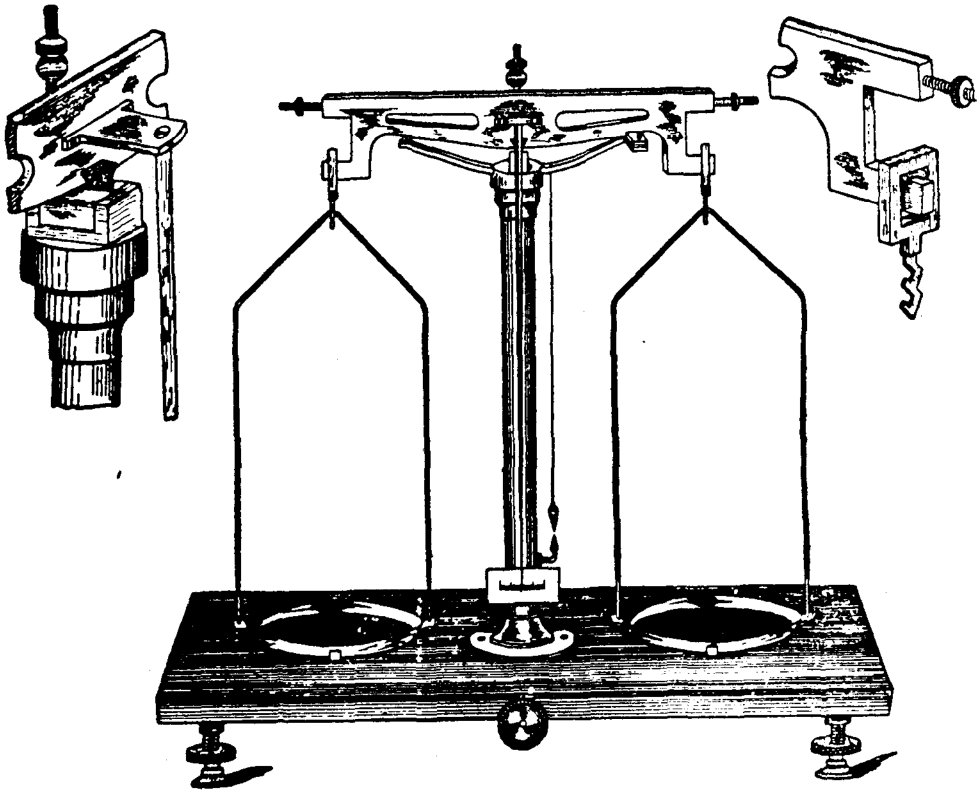

FIG. 1 BEAM SCALE

3.3 Error (Due to Inequality of Arms)

The error due to inequality of arms of a beam scale under specified load condition is equal to the mass of the additional weights required to bring to equipoise the balance, carrying weights of equal masses in the pans.

3.4 Greatest Error (Due to Inequality of Arms)

The greatest error due to inequality of arms is the error determined with two weights each equal to the capacity (full load) of the balance (*see* **3.3**).

4 CLASSES AND CAPACITIES

4.1 Beam scales shall be of any one of the four classes, namely, A, B, C and D (*see* **4.3**), based on limits for sensitivity figure sensitiveness and greatest error specified in Tables 1 to 4 respectively.

Table 1 Limits for Sensitiveness and Greatest Error for Beam Scales, Class A

(*Clauses* 4.1, 4.2, 8.1 *and* 8.2.2)

Capacity	Sensitiveness Per Division of Scale at No Load and at Full Load	Greatest Error Allowed when Fully Loaded
(1)	(2)	(3)
	mg	mg
2 g	0·02	0·04
5 g	0·05	0·10
10 g	0·10	0·20
20 g	0·20	0·40
50 g	0·50	1
100 g	1	2
200 g	2	4
500 g	5	10
1 kg	10	20
2 kg	20	40
5 kg	30	60
10 kg	50	100
20 kg	100	200
50 kg	200	400

Table 2 Limits for Sensitiveness and Greatest Error for Beam Scales, Class B

(*Clauses* 4.1, 4.2, 8.1 *and* 8.2.2)

Capacity	Sensitiveness at Full Load	Greatest Error Allowed when Fully Loaded
(1)	(2)	(3)
2 g	1 mg	2 mg
5 g	2 mg	4 mg
10 g	3 mg	6 mg
20 g	5 mg	10 mg
50 g	10 mg	20 mg
100 g	20 mg	40 mg
200 g	30 mg	60 mg
500 g	50 mg	100 mg
1 kg	100 mg	200 mg
2 kg	200 mg	400 mg
5 kg	300 mg	600 mg
10 kg	500 mg	1 g
20 kg	1 g	2 g
50 kg	2 g	4 g
100 kg	5 g	10 g
200 kg	10 g	20 g

Table 3 Limited for Sensitiveness and Greatest Error for Beam Scales, Class C

(*Clauses* 4.1, 4.2, 8.1 *and* 8.2.2)

Capacity	Sensitiveness at No Load and at Full Load	Greatest Error Allowed when Fully Loaded
(1)	(2)	(3)
100 g	100 mg	200 mg
200 g	200 mg	400 mg
500 g	500 mg	1 g
1 kg	1 g	2 g
2 kg	2 g	4 g
5 kg	3 g	6 g
10 g	5 g	10 g
20 kg	10 g	20 g
50 kg	15 g	30 g
100 kg	25 g	50 g
200 kg	50 g	100 g
300 kg	75 g	150 g
500 kg	100 g	200 g
1 000 kg	150 g	300 g

Table 4 Limits for Sensitiveness and Greatest Error for Beam Scales, Class D

(*Clauses* 4.1, 4.2, 8.1 *and* 8.2.2)

Capacity	Sensitiveness at No Load and at Full Load	Greatest Error Allowed when Fully Loaded
(1)	(2)	(3)
kg	g	g
1	1	2
2	2	4
5	5	10
10	10	20
20	20	40
50	30	60
100	50	100
200	100	200
300	150	300
500	200	400
1 000	300	600

4.2 Beam scales of the different classes shall be of one of the capacities mentioned in Tables 1 to 4.

4.3 The trades for which the different classes of scales are intended to be used are given below for the sake of guidance.

Class of Scale	
A	Assay and precision weighments
B	Weighment of precious stones and metals, jewels, pearls, bullion, saffron and similar expensive commodities, chemicals and drugs, perfumery, etc
C	Weighment of base metals and relatively costlier commodities, such as cotton, cereals, tea, coffee, tobacco, jute, dry fruits, spices, oil-seeds, etc
D	Weighment of relatively cheaper commodities, such as scrap iron, fuel wood, charcoal, vegetables, etc.

5 MATERIALS

5.1 Material for Class A Beam Scales

Class A beam scales shall be made of non-magnetic materials only except knife-edges and bearings.

5.2 Material for Other Classes of Beam Scales

Beams and pans shall be made of stainless steel, mild steel, brass or bronze. Aluminium alloy may be used in the smaller denomination balances, having a capacity of not more than 50 g. The pans of Class B beam scales may be made of glass also. In the case of beam scales of Classes C and D, pans of hardwood shall be permitted for capacities 100 kg and above. The pans of beam scales, when made of timber, shall be adequately re-inforced and protected against wear.

5.3 Suspension

Pans shall be suspended from the beam by metal chains through stirrups, hooks or rings except those of 100 g and smaller capacity of Class B beam scale which may be suspended by silk or nylon threads.

5.4 The materials for construction should preferably conform to Indian Standards where these are available. Use of mild steel conformity to Grade A of IS 2062 : 1984. Cast bronze conforming to Grade 2 of IS 306 : 1983 and aluminium alloy, 31 000 (NS 3) conforming to IS 737 : 1986 or equivalent is recommended.

5.5 All mild steel parts used in beam scales shall be suitably protected against rust.

6 CONSTRUCTION

6.1 Knife-Edges and Bearings

6.1.1 The knife-edges and bearings used in beam scales shall be of one of the following types:

a) '*Agate-box*' — Wherein agate bearings are fitted in a brass or iron box, with side holes which permit the projecting ends of the knife-edges to pass into the boxes and rest on or rise to their bearings (*see* Fig. 2).

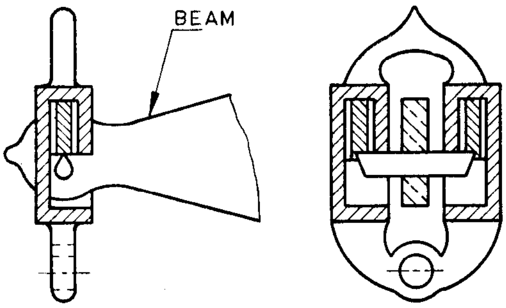

FIG. 2 AGATE-BOX BEAM

b) '*Dutch-end*' — Wherein the end bearings are fixed inside plates bolted together across the beam to form a shackle (*see* Fig. 3).

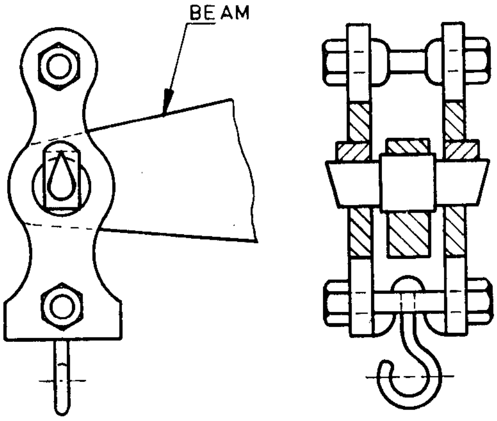

FIG. 3 DUTCH-END BEAM

c) '*Swan-neck*' — Wherein the ends are curved and slotted, the bottom of the slot forming a knife-edge, the extremities of the beam being widened in a direction at right angles to its length so that the base of the slot is parallel to the central knife-edge (*see* Fig. 4).

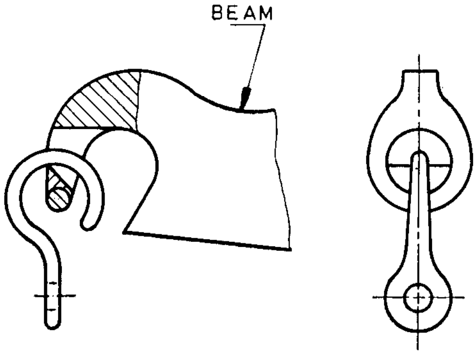

FIG. 4 SWAN-NECK BEAM

d) '*Continuous knife-edge*' — Wherein the knife-edges bear along their whole length (*see* Fig. 5).

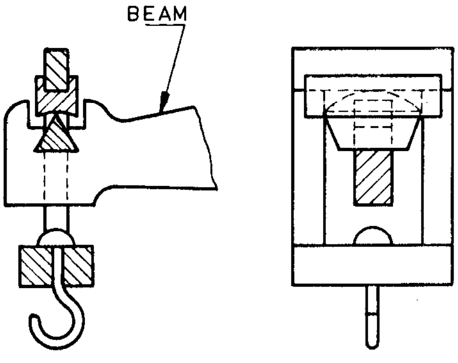

FIG. 5 CONTINUOUS KNIFE-EDGE

6.1.2 Class A beam scales shall have continuous knife-edges and shall be provided with means for relieving all the knife-edges from the bearings.

6.1.3 Class B beam scale shall not have swan-neck fittings.

6.2 Pan

If agreed to between the purchaser and the supplier, Class C beam scales may be provided with an open type pan (*see* Fig. 6).

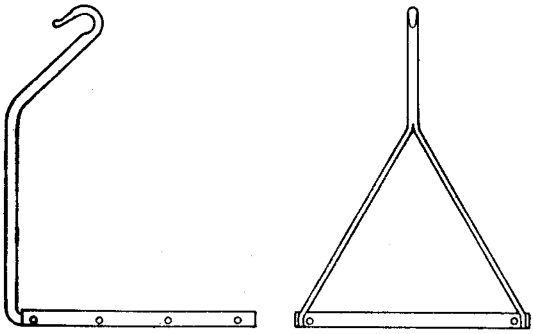

FIG. 6 OPEN TYPE PAN

6.3 Glass Case

Every beam scale of Class A shall be provided with a glass case. It shall also be provided with bubble or a plumb line and levelling screws to facilitate levelling of the instrument.

6.4 Leading Dimensions

6.4.1 No dimensions have been specified for Class A beam scales.

6.4.2 Beam scales of Classes B, C and D shall have the leading dimensions specified in Tables 5 to 9 and Fig. 7 to 11 as applicable to within the tolerances specified in **6.5**. For Class C beam scales of capacities 5 kg and below fixed hooks may also be provided.

NOTE — Class D beam scales shall be distinguished from Class C scales by the existence of two identical holes, 5 to 10 mm in diameter through the beam, one on either side of the central knife-edge (*see also* Fig. 11).

6.5 Permissible Variation in Dimensions

The dimensions of the beam scales shall not vary by more than 10 percent of the dimensions prescribed in Tables 5 to 9.

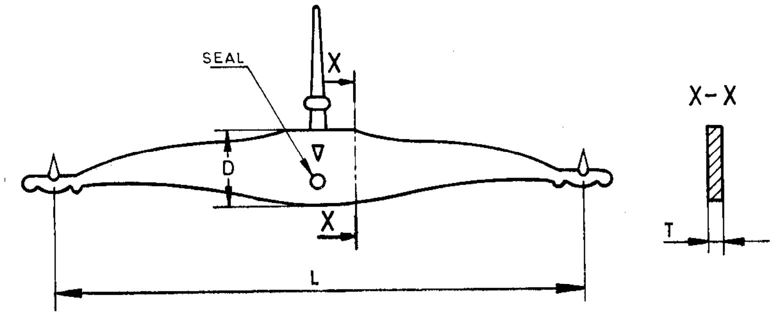

FIG. 7 BEAM SCALE, CLASS B (FLAT TYPE)

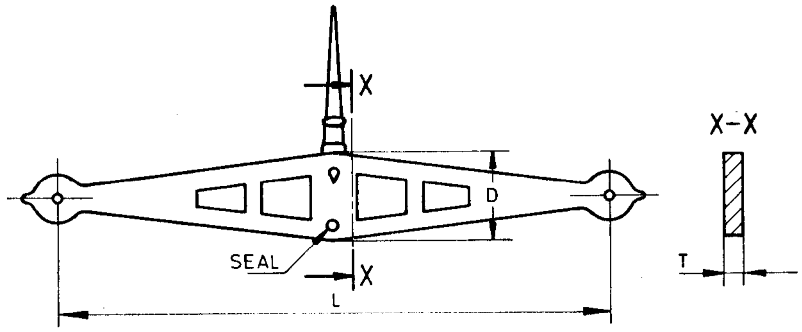

FIG. 8 BEAM SCALE, CLASS B (OPEN PATTERN TYPE)

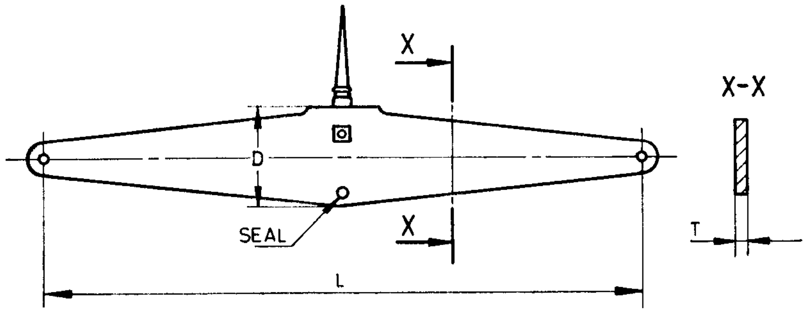

FIG. 9 BEAM SCALE, CLASS C (DUTCH-END TYPE)

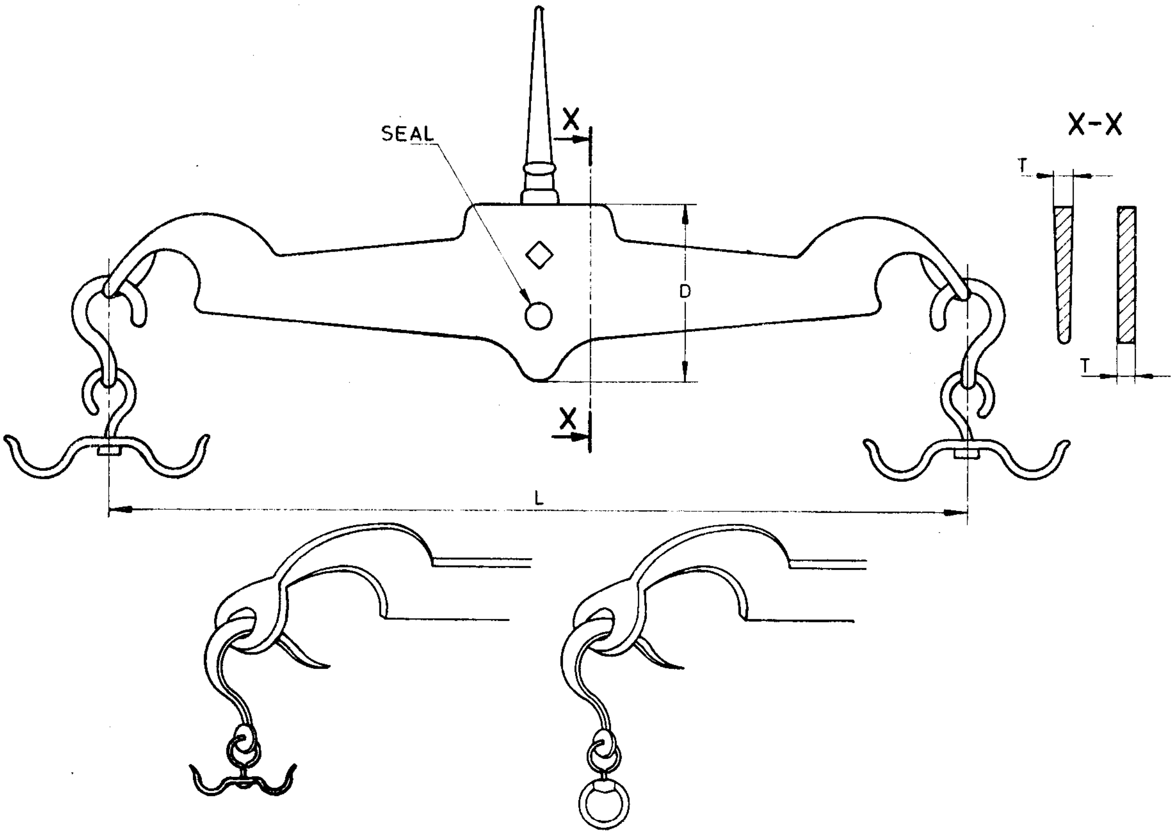

FIG. 10 BEAM SCALE CLASS C (SWAN-NECK WITH DETACHABLE FLAT HOOKS)

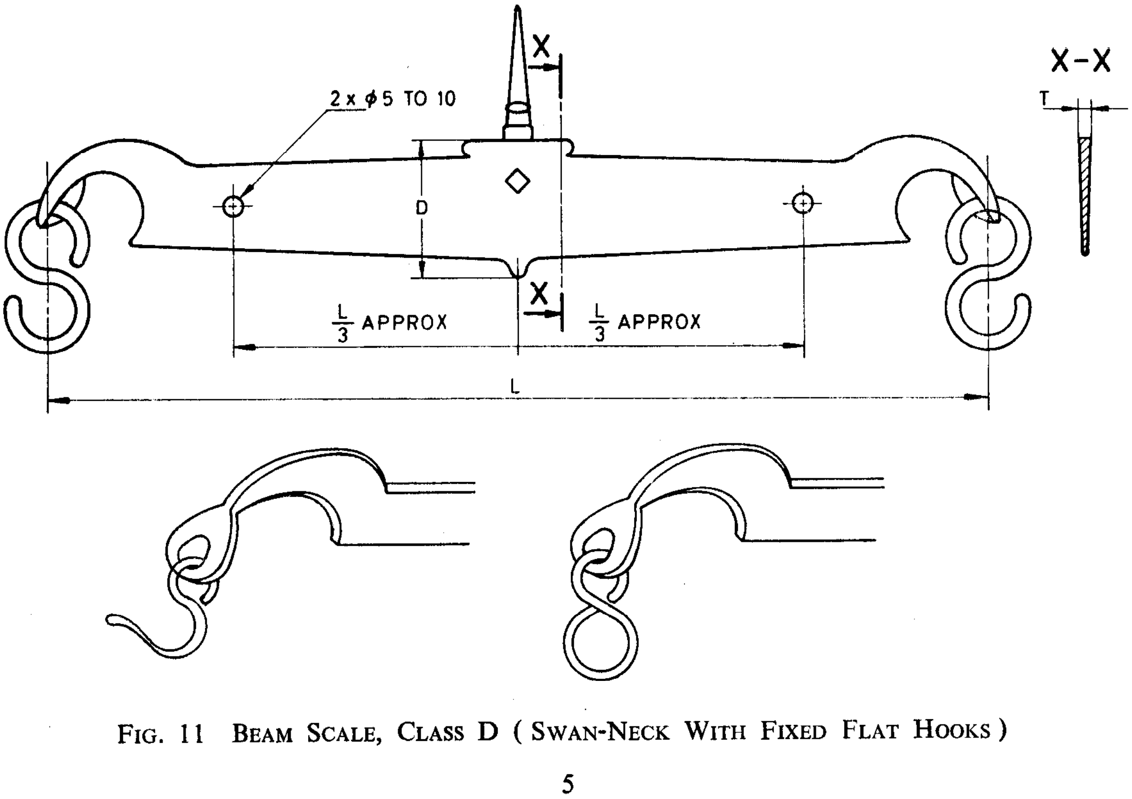

FIG. 11 BEAM SCALE, CLASS D (SWAN-NECK WITH FIXED FLAT HOOKS)

Table 5 Leading Dimensions of Beam, Class B (With Pointer Above the Beam)

(*Clauses* 6.4.2 *and* 6.5; and *Fig.* 7 *and* 8)

Capacity (1)	Length Between the Ends (Nominal) *L* (2) mm	Depth at the Centre (Nominal) *D* (3) mm	Thickness of Plate at the Centre (Nominal) *T* (4) mm
	Flat Type		
2 g	70	10	2
5 g	95	12	2
10 g	110	15	2
20 g	120	20	3
50 g	135	22	3
100 g	150	25	4
200 g	170	25	5
500 g	200	30	5
1 kg	250	40	6
2 kg	300	45	6
5 kg	450	50	6
10 kg	500	58	8
20 kg	600	58	10
50 kg	750	100	15
100 kg	1 000	110	18
200 kg	1 250	125	25
	Open Pattern (Bridge) Type		
200 g	170	25	5
500 g	260	37	5
1 kg	310	44	5
2 kg	350	48	5
5 kg	450	60	6
10 kg	500	70	8
20 kg	600	80	10
30 kg	750	120	15
100 kg	1 000	150	20

Table 6 Leading Dimensions of Beam, Class B (Flat and Open Pattern Type With Pointer Below the Beam)

(*Clauses* 6.4.2 *and* 6.5)

Capacity (1)	Length Between Ends (Nominal) *L* (2) mm	Depth at the Centre (Nominal) *D* (3) mm	Thickness of Plate at the Centre Knife-Edge (Nominal) *T* (4) mm
2 g	70	3	2
5 g	95	3	2
10 g	110	4	2
20 g	120	20	3
50 g	135	20	3
100 g	150	20	4
200 g	200	20	6
500 g	235	25	8
1 kg	300	30	8
2 kg	320	30	8
5 kg	350	30	10
10 kg	400	40	12
20 kg	500	50	14
50 kg	700	70	18
100 kg	800	80	20
200 kg	1 250	125	25

Table 7 Leading Dimensions of Beam, Class C (Swan-Neck Type)

(*Clauses* 6.4.2 *and* 6.5)

Capacity (1)	Length Between the Ends (Nominal) *L* (2) mm	Depth at the Centre (Nominal) *D* (3) mm	Thickness of Plate at the Centre Knife-Edge (Nominal) *T* (4) mm
100 g	150	30	4
200 g	200	40	5
500 g	300	40	6
1 kg	350	45	6
2 kg	400	45	6
5 kg	550	70	6
10 kg	600	80	6
20 kg	750	108	8
50 kg	900	116	11
100 kg	1 200	138	14
200 kg	1 350	148	16
300 kg	1 650	154	18
500 kg	1 800	178	25
1 000 kg	2 000	200	32

Table 8 Leading Dimensions of Beam, Class C (Dutch-End Type)

(*Clauses* 6.4.2 *and* 6.5 and *Fig.* 9)

Capacity (1)	Length Betbeen the Ends (Nominal) *L* (2) mm	Depth at the Centre (Nominal) *D* (3) mm	Thickness of Plate at the Centre Knife-Edge (Nominal) *T* (4) mm
100 g	150	35	4
200 g	200	40	5
500 g	300	40	6
1 kg	350	45	6
2 kg	400	45	6
5 kg	450	70	6
10 kg	450	75	8
20 kg	600	75	8
50 kg	750	80	8
100 kg	900	120	14
200 kg	900	133	16
300 kg	1 050	142	16
500 kg	1 350	192	20
1 000 kg	1 650	203	25

Table 9 Leading Dimensions of Beam, Class D (Swan Neck)

(*Clauses* 6.4.2 *and* 6.5 and *Fig.* 10 *and* 11)

Capacity (1) kg	Length Between the Ends (Nominal) *L* (2) mm	Depth at the Centre (Nominal) *D* (3) mm	Thickness of Plate at the Centre Knife-Edge (Nominal) *T* (4) mm
	Swan-Neck with Fixed Flat Hooks		
1	350	45	6
2	400	45	6
5	550	70	6
10	600	80	6
20	750	108	6
50	900	116	8
100	1 200	138	14
200	1 350	148	16
300	1 650	154	18
	With Detachable Flat Hooks		
500	1 800	178	25
1 000	2 000	200	32

6.6 Attachment for Adjusting the Balance of a Beam Scale

6.6.1 Beam scales of Classes, B, C and D shall be provided with a balance ball or balance box securely attached to one of the suspension chains or pans in such a manner that it is not possible to alter it easily. The balance ball or balance box shall not be so large as to contain more loose material than an amount exceeding one percent in weight of the capacity of beam scales under 100 kg or an amount exceeding 1 kg for beam scales of capacity 100 kg and above.

6.7 Arrangement for Adjusting Sensitiveness

Beam scales of Class A shall be provided with an attachment for adjusting the sensitivity figure. Beam scales of other classes shall not be provided with an attachment to adjust their sensitiveness.

7 GENERAL REQUIREMENTS

Beam scales shall comply with the general requirements specified in IS 1432 : 1959.

8 TESTS

8.1 Sensitiveness

Class A beam scales shall be tested for sensitiveness at zero and full loads and shall comply with the requirements specified in Table 1. Beam scales other than Class A shall be tested for sensitiveness at full load only and shall comply with the requirements specified in Tables 2 to 4.

8.1.1 *Class A Beam Scales*

For determining the sensitivity figure of a Class A beam scale at no load, the beam scale shall be properly balanced without any load in the pans. A small weight whose mass is accurately known shall be put on one of the pans. This small weight shall be so chosen that the turning points of the pointer remain within the reading index. The rest point shall be determined by the usual oscillation method. The weight shall then be transferred to the other pan and the second rest point shall be determined. The shift of the rest point is a measure of sensitiveness. If this shift is 'n' divisions of the scale and if the mass of the test weight is 'w' mg, the sensitiveness 'S', in milligrams per division, at no load, is given by the relation:

$$S = \frac{2\mathrm{w}}{n}$$

A similar test with appropriate weights in each pan representing the full capacity of the beam scale, shall be performed to determine the sensitiveness of the beam scale at full load.

8.1.1.1 *Class A beam scales 2 g to 20 g*

As it is not practicable to make weights of denominations smaller than one milligram, the sensitivity figure of beam scales of smaller capacities, that is, from 2 g to 20 g shall be determined by means of a pair of weights, each weight having a mass of approximately 5 mg. The difference in the masses of the two weights in the pair shall be adjusted to be of the order to 0·05 mg, 0·12 mg, 0·25 mg or 0·50 mg depending on the beam scale under test, that is, for testing 2 g, 5 g, 10 g and 20 g beam scale, respectively. This difference should be known accurately. After balancing the beam scale at zero load, one of the two weights in the pair shall be put on the right pan and the other weight on the left pan. The rest point shall be determined. The two weights shall then be interchanged and the second rest point shall be similarly determined. If the rest point shifts by 'n' divisions and if the difference between the masses of the two test weights is 'w' mg, the sensitiveness 'S' of the beam scale in milligrams per division at zero load is given by the relation:

$$S = \frac{2\mathrm{w}}{n}$$

To determine the sensitiveness of the beam scale at full load a similar test shall be performed with weights equal to the maximum capacity of the beam scale in each pan.

8.1.2 *Beam Scales of Classes Other than A with Pointer Beam*

Pans of a beam scale other than Class A, shall be loaded with weights representing its full capacity and the scale balanced. Weights of such mass shall then be added on one of the pans as may move the tip of the pointer from its equilibrium position by an appreciable distance. After removing these weights the same test shall be repeated on the other pan and the weights required for moving the tip of the pointer by the same distance on the other side of the equilibrium position shall then be added. If these weights are denoted by 'w_1' and 'w_2' respectively, the sensitiveness 'S' of the beam scale is given by the relation:

$$S = \frac{w_1 + w_2}{2}$$

8.2 Inequality of Arms Test

8.2.1 *Class A Beam Scale*

The error due to inequality of arm of Class A beam scale shall be determined by the following method. The beam scale shall be properly balanced without any load in the pan. The rest point (R_0) shall be determined by the usual oscillation method. After arresting the beam both the pans shall be loaded with equal weights of same material and representing the full capacity of the beam scale. The beam scale shall then be properly balanced by adding small weights. The rest point (R_1) shall be determined by the oscillation method. After arrresting the beam, the loads, including the small weights, shall be interchanged and scale balanced again by putting additional weights (m), if necessary on one of the pans. The rest point (R_2) shall be again determined. Then error (E) caused due to inequality of the arms of the scale is given in

$$E = \frac{m}{2} + \frac{(R_1 + R_2)}{2} - R_0 \; S$$

Where S is the sensitivity figure of the beam scale.

8.2.2 *Beam Scales Other than Class A*

In the case of beam with fixed hooks the beam with hooks but without chains and pans shall be checked for balance. If detachable hooks are provided, the beam alone shall be checked. The loose hooks shall then be attached and the assembly checked for balance. The chains and pans shall then be attached in the case of both the types of balances and checked again for balance.

After checking at no load, each of the pans shall be loaded with weights equal to the marked capacity of the scale and the scale shall be balanced.

The loads thereon shall then be interchanged and the beam scale balanced again by adding necessary weights on one of the pans. The additional weight shall be equal to twice the error due to inequality of arms of the beam.

In the case of beams with attached hooks, the loads shall be interchanged along with the chains and pans and in the case of beams with detachable hooks the loads shall be interchanged along with the hooks chains and pans.

8.2.3 The figure so obtained shall be halved to detemine the error at full-load. These should lie within the limits specified in Tables 1 to 4.

8.3 Shift Test

8.3.1 *Beam Scales Other than Class A*

With the pans loaded to half the capacity, no appreciable difference in the accuracy of the instrument shall result from moving the knife-edges or bearings laterally or backwards and forwards within their limits of movement.

Similarly, when the above load is moved to any position on the pan, the difference shown shall not be appreciable.

NOTE — The words 'appreciable difference' shall mean 'a difference which can be detected', but the testing authority should exercise its discretion in each particular case.

9 MARKING

9.1 Beam scales shall be prominently, legibly and indelibly marked with the maker's name or his registered trade-mark, model, capacity and class (wherever applicable).

NOTE — The manufacturer's name or the registered trade-mark shall be such as will not be mistaken for the stamp or the seal of the verification authority.

9.2 Beam scales shall have inscribed on them their maximum capacity in the following manner as may be appropriate:

'To weigh......t'
'...टन के लिए...'

'To weigh......kg'
'...किलो के लिए...'

'To weigh......g'
'...ग्राम के लिए....'

10 SEALING

All beam scales shall be provided by the manufacturer with a plug/plugs or stud/studs of soft metal to receive the stamp or seal of the verifying authority. Such plug/plugs or stud/studs shall be provided in a conspicuous part of the instrument and shall be made in such a manner as to prevent its removal without obliterating the seal/seals.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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